USN ☐☐☐☐☐☐☐☐☐☐ 06CIV13/23

First/Second Semester B.E. Degree Examination, June/July 2011
Elements of Civil Engineering and Engineering Mechanics

Time: 3 hrs.   Max. Marks:100

Note:*1.Answer FIVE full questions choosing at least two from each part.*
2.Answer all objective type questions only in OMR sheet page 5 of the Answer Booklet.
3.Answers to objective type questions on sheets other than OMR will not be valued.

PART – A

1   a.   Select the correct answer :
   i)   The topmost layer of the road over which the traffic moves is
        A) Edging   B) Wearing coat   C) Bern   D) Pavement
   ii) The branch of civil engineering which deals with planning scheduling and execution of project is
        A) Geotechnical Engg.   B) Surveying
        C) Construction Technology and management D) Structural Engg.
   iii) The bridges of span between 8 m and 30 m are
        A) Minor bridges B) Major bridges   C) Culverts   D) Longspan bridges.
   iv) Bituminous road is also known as
        A) Flexible pavement   B) Rigid pavement
        C) Kankar road   D) Moorum road.   **(04 Marks)**

   b.   What is meant by surveying? Write a brief note on classification based on nature of field survey.   **(08 Marks)**

   c.   Briefly explain the following specialization of civil engineering:-
        i) Geotechnical Engineering   ii) Transportation Engineering   **(08 Marks)**

2   a.   Select the correct answer :
   i)   Branch of mechanics which deals with the motion of bodies referring to the forces causing the motion is
        A) Kinetics   B) Kinematics   C) Statics   D) Viscous fluid
   ii) Geometrical representation of moment of a force about a point is given by
        A) Area of triangle   B) Twice the area of triangle
        C) Thrice the area of triangle   D) Twice the area of rectangle
   iii) A single force which can nullify the effect of system of forces is
        A) Resultant   B) Couple   C) Equilibrant   D) Moment
   iv) If a given force system can be replaced by another system with exactly same net effect as given system, the two systems are said to be
        A) Equivalent   B) Concurrent   C) Unequivalent   D) Continuous   **(04 Marks)**

   b.   Resolve 400 N force acting on a block as shown in Fig.Q2(b) into two components as given below.   a) Horizontal and vertical components.   b) Along the inclined plane and at right angles to the plane.   **(08 Marks)**
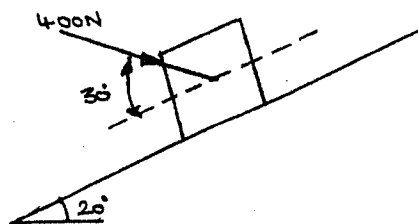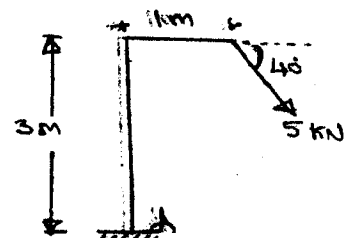

Fig.Q2(b)   Fig.Q2(c)

   c.   Determine the moment of force about "A" shown in Fig.Q2(c).
   d.   Explain the principle of transmissibility of force.   **(04 Marks)**

3 a. Select the correct answer :
   i) Maximum and minimum resultant of two concurrent forces 20 kN and 12 kN are
       A) 40 & 24 kN   B) 32 & 8 kN   C) 10 & 6 kN   D) None of these.
   ii) A couple consists of
       A) two equal parallel and opposite forces separated by a distance
       B) two equal and like parallel forces
       C) two unequal and like parallel forces
       D) None of these.
   iii) Resultant of two unlike parallel forces 10 kN and 15 kN is
       A) 25 kN   B) 5 kN   C) 150 kN   D) None of these
   iv) Varignon's theorem is applicable to
       A) only coplanar force system   B) only concurrent force system
       C) only nonconcurrent force system   D) coplanar, concurrent and nonconcurrent systems
                                                                            (04 Marks)

   b. A dam section is shown in Fig.Q3(b). Determine the magnitude, direction and position of
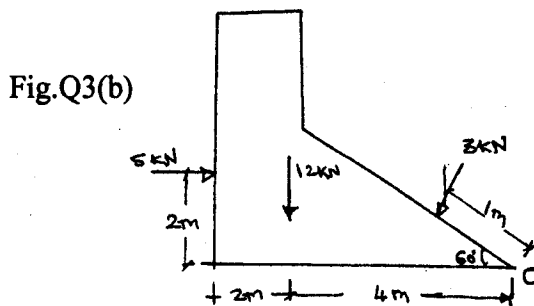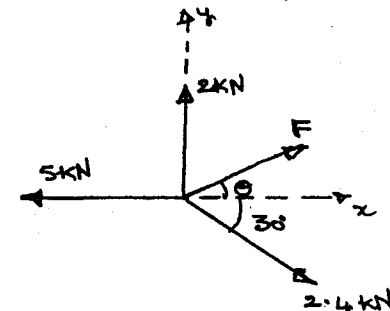   resultant with respect to 'O'.   (08 Marks)

Fig.Q3(b)

Fig.Q3(c)

   c. 2 kN force is the resultant of system of forces acting up along y-axis as shown in Fig.Q3(c).
       Determine the value of F and θ.   (08 Marks)

4 a. Select the correct answer :
   i) Centroid of a lamina must be
       A) within lamina   B) Outside the lamina
       C) Not necessarily with in lamina   D) None of these.
   ii) Centroid of a sector hich is symmetrical about horizontal axis is given by
       A) $\dfrac{2R}{3\alpha}\sin\alpha$ B) $\dfrac{4R}{3\alpha}\sin\alpha$ C) $\dfrac{2R}{3\alpha}\cos\alpha$ D) $\dfrac{2R}{4\alpha}\sin\alpha$
   iii) The centroid of lamina is determined by the principle of
       A) Lami's theorem   B) Varignon's theorem
       C) Triangle law of forces   D) None of these.
   iv) One of the coordinates of centroid of a lamina symmetrical about vertical axis with a
       width of 200mm and depth 150mm is
       A) 100 mm   B) 75 mm   C) 200 mm   D) 150 mm   (04 Marks)

   b. Determine the centre of gravity of the lamina shown in Fig.Q4(b) with respect to O.

Fig.Q4(b)
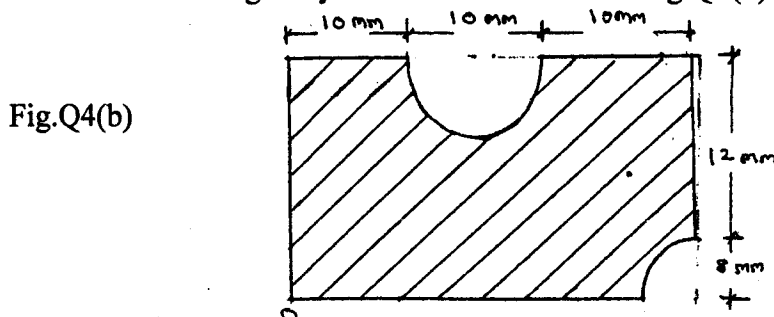
                                                                            (12 Marks)

   c. Locate the centroid of right angled triangle from first principles.   (04 Marks)

PART – B

5 a. Select the correct answer :
   i) Lami's theorem is applicable for
       A) coplanar concurrent forces   B) Non coplanar concurrent forces
       C) coplanar nonconcurrent forces   D) Parallel forces.
   ii) Forces in equilibrium produce
       A) Maximum resultant   B) Maximum moment
       C) Zero resultant   D) Maximum torque
   iii) A body lies in equilibrium under the action of three forces when
       A) Resultant of any two forces is equal, opposite and colinear with third force
       B) Resultant of any two forces is equal, parallel and colinear with third force
       C) Resultant of any two forces is unequal, opposite and colinear with third force
       D) All three forces are like parallel forces.
   iv) The reaction at the surface of contact of a sphere is
       A) parallel to the surface of contact   B) normal to the surface of contact
       C) inclined to the surface of contact   D) None of these.   **(04 Marks)**
   b. Determine the forces in the wires shown in Fig.Q5(b).   **(10 Marks)**

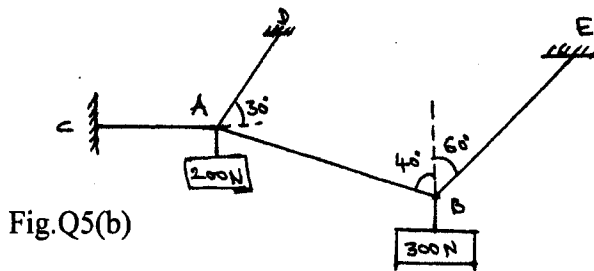
Fig.Q5(b)
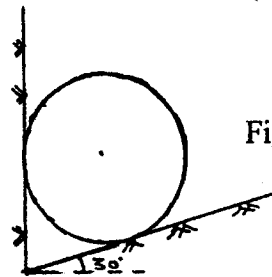
Fig.Q5(c)

   c. A sphere of weight 300 N rests on an incline as shown in Fig.Q5(c). Determine the surface reactions.   **(06 Marks)**

6 a. Select the correct answer :
   i) A beam supported by roller and hinge supports subjected to only vertical loads has
       A) Vertical and horizontal reactions   B) Two vertical reaction
       C) Two horizontal reactions   D) One vertical and a moment.
   ii) A determinate beam can be analyzed by applying maximum
       A) two conditions of equilibrium   B) three conditions of equilibrium
       C) four conditions of equilibrium   D) one vertical and a moment.
   iii) Water in a tank is an example of
       A) point load   B) Udl   C) UVL   D) None.
   iv) A cantilever beam is one
       A) whose ends are fixed
       B) whose both ends are simply supported
       C) whose one end is fixed and the other simply supported
       D) whose one end is fixed and the other end free.   **(04 Marks)**
   b. What is the difference between determinate and indeterminate beams?   **(04 Marks)**
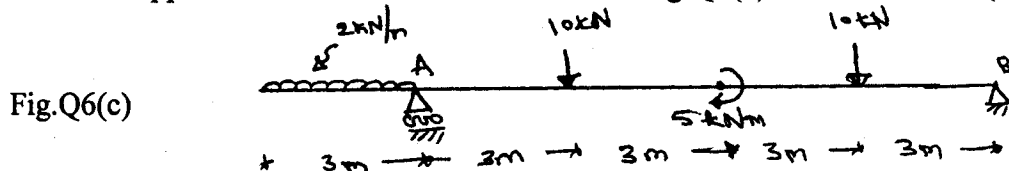   c. Determine the support reactions for the beam shown in Fig.Q6(c).   **(06 Marks)**

Fig.Q6(c)

   d. Two men A & B carry a stone block weighing 2 kN, suspending the stone block on a horizontal beam and carrying it on their shoulders at each end. The beam is 2 m long and is of weight 580 N/m. A can carry maximum weight of 1.2 kN and B can carry a weight of 0.9 kN. Determine the distance at which the stone block is suspended from the end carried by A.   **(06 Marks)**

3 of 4

7 a. Select the correct answer :
   i) The force of friction is independent of
      A) force applied on body   B) weight of body
      C) velocity of sliding   D) None of these.
   ii) The body remains at rest as along as the frictional force is
      A) Equal to the force applied   B) Greater than the force applied
      C) Less than the force applied   D) None of these.
   iii) Solid friction is the friction between two surfaces
      A) when no lubrication is used   B) when lubrication is used
      C) when surfaces are heated   D) None of these.
   iv) Ratio of limiting force of friction to the normal reaction is
      A) Angle of friction   B) Coefficient of friction
      C) Angle of repose   D) None of these.   **(04 Marks)**

 b. What is meant by 'angle of repose'? Show that angle of repose is equal to angle of friction.
   (08 Marks)

 c. A uniform ladder of weight 850 N and of length 6 m rests on a horizontal ground and leans against a smooth vertical wall. The angle made by the ladder with the horizontal is 65° ⌐ When a man of weight 700 N stands on the ladder at a distance of 4 m from the top of the ladder, the ladder is at the point of sliding. Determine the coefficient of friction between the ladder and the floor.
   (08 Marks)

8 a. Select the correct answer :
   i) M.I. of an annular area with outer radius 0.8m and inner radius 0.5m is
      A) $0.2726 \, m^4$ B) $0.3726 \, m^4$ C) $1.222 \, m^4$ D) None of these
   ii) The distance at which an area can be imagined to be placed and squeezed, so that there is no change in moment of inertia is known as
      A) Radius of gyration   B) Polar moment of inertia
      C) Moment of area   D) Second moment of area
   iii) Moment of inertia is
      A) Resistance to change in rotational motion
      B) Acceptance to change in rotational motion
      C) Resistance to deformation
      D) None of the above.
   iv) M.I. of a rectangle about the base is
      A) $\dfrac{bd^3}{6}$ B) $\dfrac{bd^3}{3}$ C) $\dfrac{bd^3}{12}$ D) $\dfrac{db^3}{12}$ **(04 Marks)**

 b. State and prove parallel axis theorem.   **(06 Marks)**

 c. Determine M.I. about horizontal centroidal axis for the shaded area shown in Fig.Q8(c). Also find radius of gyration about the same axis.   **(10 Marks)**
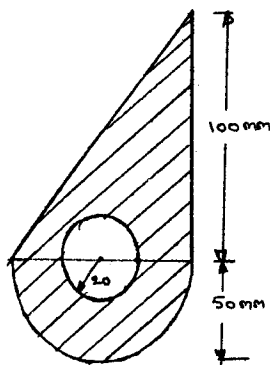

Fig.Q8(c)

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First/Second Semester B.E. Degree Examination, June/July 2011
Elements of Civil Engineering and
Engineering Mechanics

Time: 3 hrs. Max. Marks:100

Note: 1. *Answer any FIVE full questions, choosing at least two from each part.*
2. *Answer all objective type questions only in OMR sheet page 5 of the answer booklet.*
3. *Answer to objective type questions on sheets other than OMR will not be valued.*

PART – A

1 a. Choose your answers for the following :
  i) Geotechnical engineering involves the study of
   A) Building B) Soil C) Air D) All the above
  ii) Building tanks and dams and carrying stored water to field is known as
   A) Structural engineering. B) Environmental engineering.
   C) Water resources and irrigation engg. D) Construction technology.
  iii) The structure which provides passage over the obstacles like valley, river without closing the way underneath is:
   A) Dam B) Bridge C) Harbour D) Airport
  iv) Highways which are superior to National Highways and are provided wherever volume of traffic is very high are:
   A) State highways B) High volume roads C) Air ways D) Expressways
  (04 Marks)

 b. Explain briefly the scope of civil engineering in:
   i) Water resources engineering; ii) Geotechnical engineering **(10 Marks)**
 c. Explain different types of roads. **(06 Marks)**

2 a. Choose your answers for the following :
  i) Which of the following is the basic concept of mechanics?
   A) Charge B) Power C) Force D) Energy
  ii) When more than three concurrent forces are in equilibrium, select the condition that is satisfied.
   A) All the forces must have equal magnitude.
   B) Polygon representing the forces will not close.
   C) The last side of the polygon will represent the resultant.
   D) Polygon representing the forces will close.
  iii) Effect of a force on a body depends upon its:
   A) Direction B) Position C) Magnitude D) All the above
  iv) Forces coexist on a plane and all the forces act helter-skelter over the body. These are
   A) Coplanar non-concurrent forces B) Coplanar concurrent forces
   C) Coplanar parallel forces D) Non-coplanar non-concurrent forces
  (04 Marks)
 b. State and explain basic idealization in mechanics. **(06 Marks)**
 c. Define a couple. Mention its characteristics. **(04 Marks)**
 d. A 100N verticle force is applied to the end of a lever which is attached to a shaft as shown in Fig. Q2 (d), determine
   i) The moment of force about 0.
   ii) The horizontal force applied at 'A' which creates same moment about '0'.
   iii) The smallest force applied at 'A' which creates same moment about '0'. **(06 Marks)**
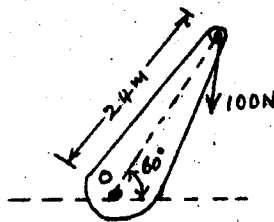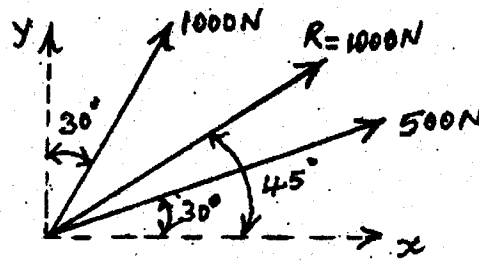
Fig. Q2(d)

Fig. Q3(c)

3 a. Choose your answers for the following :
   i) If two equal forces of magnitude 'p' act at an angle 'θ', their resultant will be
   A) $2p \cos \theta/2$ B) $P \tan \theta/2$ C) $2p \sin \theta/2$ D) $p \cos \theta/2$
   ii) The simplest resultant of a plane force system is always
   A) A single force   B) A wrench   C) A single moment
   D) A single force or a single moment.
   iii) The angle between two forces to make their resultant a minimum and a maximum respectively are:
   A) 0^0 and 90^0 B) 180^0 and 90^0 C) 90^0 and 180^0 D) 180^0 and 0^0
   iv) The moment of a force about any point is numerically equal to ……….. times the area of the triangle whose base is the line representing the force and vertex is the point about which the moment is taken
   A) Half   B) Same   C) Twice   D) Thrice
   (04 Marks)

   b. State and prove Varignon's theorem of moments. **(10 Marks)**
   c. Two forces acting on a body are 500N and 1000N as shown in Fig. Q3 (c). Determine the third force F such that the resultant of all the three forces is 1000N directed at 45^0 to the x-axis. **(06 Marks)**

4 a. Choose your answers for the following :
   i) The first moment of area of a semicircular area about its diameter d is given by
   A) $\dfrac{d^3}{12}$ B) $\dfrac{d^3}{24}$ C) $\dfrac{d^3}{6}$ D) $\dfrac{d^3}{36}$
   ii) Centroid of a triangular area of base 'b' and height 'h' taken about an axis coincident with the base is given by
   A) $\dfrac{bh^3}{12}$ B) $\dfrac{b^2h}{6}$ C) $\dfrac{bh^2}{6}$ D) $\dfrac{h}{3}$
   iii) Moment of total area about its centroidal axis is
   A) Twice the area   B) Three times the area
   C) Zero   D) none of the above
   iv) Centroid conveys some clue about
   A) The orientation of a surface   B) Centre of a body
   C) Shape and disposition of the area   D) Area of cross-section   **(04 Marks)**

   b. Determine the centroid of semicircle by the method of integration. **(06 Marks)**
   c. With reference to the co-ordinate axis x and y, locate the centreid of the area shown in Fig. Q4 (c). **(10 Marks)**
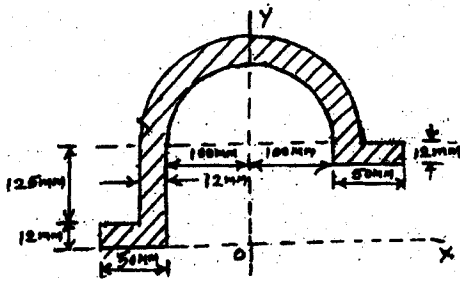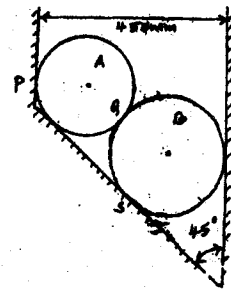
Fig. Q4(c)

Fig. Q5(c)

PART – B

5 a. Choose your answers for the following :
    i)   The force that cancels the effects of the force system acting on the body is known as
        A) Resultant   B) Neutral force   C) Balancing force   D) Equilibriant
    ii)   If the sum of all the forces acting on a body is zero it may be concluded that the body
        A) Must be in equilibrium   B) cannot be in equilibrium
        C) May be equilibrium provided the forces are concurrent.
        D) May be in equilibrium provided the forces are parallel.
    iii) For a smooth spherical surface reaction acts
        A) Horizontal to the plane of contact   B) Inclined to the plane of contact
        C) Perpendicular to the plane of contact   D) None of the above.
    iv)   A system that possesses a resultant:
        A) Will be equilibrium   B) Will be under rest
        C) Will not be in equilibrium   D) None of these   **(04 Marks)**

  b. Define free body diagram. Describe types of forces acting on a body. Explain them briefly.
                                                                    (06 Marks)

  c. Cylinder 'A' of diameter 200mm and cylinder B of diameter 300mm are placed in a trough shown in Fig. Q5 (c). If cylinder A weighs 800N and cylinder B weighs 1200N, determine the reactions developed at contact surfaces P, Q, R and S. Assume all contact surfaces are smooth.   **(10 Marks)**

6 a. Choose your answers for the following :
    i)   Minimum number of members required to form a simple truss
        A) 2   B) 3   C) 4   D) 5
    ii)   In the method of joints for the analysis of forces in the member of truss, the number of equilibrium equations available at each joint are
        A) 2   B) 3   C) 4   D) 5
    iii) For a system of coplanar parallel forces to be in equilibrium
        A) The resultant force must vanish alone is sufficient
        B) The resultant couple must vanish alone is sufficient
        C) Both resultant force and the resultant couple must vanish
        D) None of the above
    iv)   The beam is neither permitted to move in any direction nor allowed to rotate in the case of
        A) Hinged support   B) Fixed support   C) Roller support   D) Simple support
                                                                       (04 Marks)

  b. Briefly explain the method of joints and method of sections used in the analysis of simple trusses. **(06 Marks)**

  c. Determine the reactions at the support for the beam loaded shown in Fig. Q6(c). **(10 Marks)**
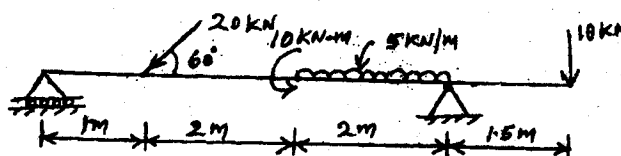

Fig. Q6(c)

7 **a.** Choose your answers for the following :

i) A body of weight Q is placed on an inclined rough plane. The inclination of the plane with the horizontal is less than the angle of friction. The body will.
A) be in motion   B) move downwards   C) be in equilibrium   D) move upwards

ii) The angle which an inclined surface makes with the horizontal when a body placed on it is in verge of moving down, is called
A) Angle of repose   B) Angle of friction   C) Angle of inclination D) None

iii) If ϕ = angle of friction and μ = coefficient of friction, then which equation is valid?

A) $\tan \phi = \mu$ B) $\tan \phi = \dfrac{1}{\mu}$ C) $\sin \phi = \mu$ D) $\cos \phi = \mu$

iv) Angle of friction is the angle between
A) The incline and horizontal
B) The normal reaction and frictional force.
C) The weight of the body and the friction force.
D) Normal reaction and the resultant.   **(04 Marks)**

b. Explain limiting friction, angle of repose and cone of friction.   **(06 Marks)**

c. A uniform ladder of 4m length rests against a vertical wall with which it makes an angle of 45^0 as shown in Fig. Q7 (c). The coefficient of friction between the ladder and the floor is 0.5. If the man whose weight is one-half of that of ladder ascends it, how high will he be when the ladder slips?   **(10 Marks)**
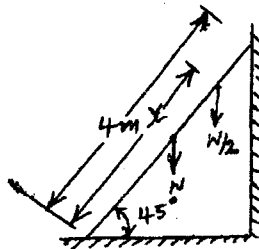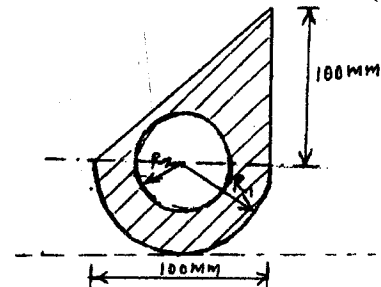

Fig. Q7(c)   Fig. Q8(c)

8 **a.** Choose your answers for the following :

i) The moment of inertia of a body is
A) Moment of its inertia
B) The rotational moment acting on the body
C) The rotational analogue of mass
D) The inertial moment acting on the body

ii) The second moment of a plane area about any axis as compared to its second moment about the neutral axis
A) Is always more   B) Is always less   C) Is equal   D) Not equal

iii) Moment of inertia of a square of side 'a' about an axis through its centre of gravity is

A) $\dfrac{a^4}{4}$ B) $\dfrac{a^4}{8}$ C) $\dfrac{a^4}{12}$ D) $\dfrac{a^4}{36}$

iv) The value of moment of inertia depends on
A) Type of material   B) Weight of material
C) Density of material   D) Cross-sectional dimensions. **(04 Marks)**

b. State and prove parallel axis theorem.   **(06 Marks)**

c. Determine the second moment of area about horizontal centroidal axis for shaded area shown in Fig. Q8 (c). Also find the radius of gyration about the same axis. Take R_1 = 50mm and R_2 = 20mm.   **(10 Marks)**

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